

TWO NEW EASTERN PACIFIC SPECIES OF *CADULUS*, WITH REMARKS ON THE CLASSIFICATION OF THE SCAPHOPOD MOLLUSKS

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ABSTRACT

Cadulus (Polyschides) *nedallisoni*, n. sp., and *C.* (Platyschides) *macleani*, n. sp., from the Gulf of California and off the coast of Nicaragua, respectively, are described and compared with related New World species. The supraspecific categories of the Class Scaphopoda are reviewed in the light of recently proposed taxonomic units.

Two previously unrecognized species of *Cadulus* from the Panamic faunal province are described, illustrated and compared with related New World species. The present specimens, collected 12 to 40 years ago, were uncovered during an examination of scaphopod material in the Los Angeles County Museum of Natural History and in material obtained by the *Zaca* Expedition to the eastern Pacific Ocean (Beebe, 1938) and transferred to the American Museum of Natural History by the New York Zoological Society. The minute size of these specimens, less than 5 mm in length, apparently has resulted in them being overlooked in the past.

It is an honor to name these new species for two valued friends and respected colleagues, respectively, James H. McLean of the Los Angeles County Museum of Natural History and the late Edwin C. Allison (1926-1971), whose untimely death deeply saddened all who knew him.

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SCAPHOPOD CLASSIFICATION

Before undertaking the description of the new species, a review of the present status of the classification is in order. The modern classification of the scaphopod mollusks dates from Pilsbry

and Sharp (1897-1898), who, following Paul Fischer (1885), recognized these animals as a distinct class of the Phylum Mollusca. They followed the two-fold division used by previous workers, placing the forms with relatively large shells and a conical foot in the family Dentaliidae. The other forms with relatively small shells and a vermiform foot with a distal disk were placed in the family Siphonodentaliidae. This division of the Scaphopoda was accepted by most subsequent workers, who have in recent years followed the fundamentally similar classifications proposed by Ludbrook (1960) and Emerson (1962). In the past few years, however, this basically pragmatic classification has been radically expanded and somewhat modified by other students.

Two authors independently presented new classificatory schemes in 1974. In the first of these, Starobogatov (published February 25, 1974), suggested that the xenochonchias were the common ancestors of the scaphopods and monoplacophorans. On the basis of what he considered to be a close similarity between the xenochonchias and the scaphopods, he recognized the Scaphopoda and Xenochonchia as subclasses of the molluscan class Solenoconchia. He continued the previous two-fold division of the scaphopods by the use of two ordinal categories within the Subclass Scaphopoda. To the order Dentaliida da Costa, 1776 (*ex-Dentalia*), he assigned the families Prodentaliidae Starobogatov, 1974¹ (with the nominate genus only included), Plagioglyptidae

Starobogatov, 1974¹ (with the nominate genus only included), and Dentaliidae Gray, 1834 (with the nominate genus and 20 other genus-group taxa afforded full generic status). Thus the genus-group taxa formerly assigned to the family Dentaliidae were retained and divided into familial groups to comprise an ordinal unit. The genus-group taxa that formed the family Siphonodentaliidae in previous classifications were also elevated by him to form an ordinal category, in which three familial units were recognized. In the order Gadilida Starobogatov 1974¹, he placed the following families: 1. Siphonodentaliidae Simroth, 1894 (including the genera *Siphonodentalium* M. Sars, 1859; *Pulsellum* Stoliczka, 1868; *Entalina* Monterosato, 1872; *Compressidens* Pilsbry and Sharp, 1897; *Entalinopsis* Habe, 1957; and *Megaentalina* Habe, 1963; 2. Loxoporidae Starobogatov, 1974¹, (nominate genus only included); and 3. Gadilidae Stoliczka, 1868 (including the genera *Cadulus* Philippi, 1844; *Gadila* Gray, 1847; *Helonyx* Stimpson, 1865; *Dischides* Jeffreys, 1867; *Polyschides* Pilsbry and Sharp, 1897 [*sic* = 1898]; *Platyschides* Henderson, 1920; *Gadilopsis* Woodring, 1925; *Striocadulus* Emerson, 1962; and *Sagamicadulus* Sakurai and Shimazu, 1963).

Later in the same year, Palmer (published October 1, 1974) reassessed and redistributed supraspecific taxonomic units within the systematic arrangement of the class Scaphopoda that was proposed by Emerson (1962). He erected the order Dentalioida Palmer, 1977¹, with two familial categories to receive the genus-group taxa formerly placed in the family Dentaliidae. He restricted the Dentaliidae Gray, 1847 [*sic* = 1834] to dentaliid-like forms with longitudinal sculpture and recognized 10 genera (3 of which are polytypic). The family Laevidentaliidae Palmer, 1974¹, was proposed for the forms with annulated sculpture of those lacking sculpture. To this family he assigned 11 genera (2 of which are polytypic), including a new genus *Progadilina* Palmer, 1974¹, (type species by original designation: *Dentalium undulatum* Münster, 1844, from the Jurassic of England). For the genus-group taxa formerly placed in the family

Siphonodentaliidae, he erected the order Siphonodentalioida Palmer, 1974¹. The family Siphonodentaliidae Simroth, 1894 was restricted by him to forms with non-constricted apical orifices. He included in this family the genera *Entalina* Monterosato, 1872 (including the non-nominate subgenera *Entalinopsis* Habe, 1957, and *Megaentalina* Habe, 1963); *Siphonodentalium* M. Sars, 1858 [*sic* = 1859]; *Pulsellum* Stoliczka, 1868; and *Calstevenus* Yancey, 1973. The siphonodentaliid-like forms with constricted apical orifices that were previously placed in the family Siphonodentaliidae were placed by him in the family Cadulidae Grant and Gale, 1931, to which five genera were assigned. These are *Gadila* Gray, 1847 (including the non-nominate subgenus *Gadilopsis* Woodring, 1925); *Polyschides* Pilsbry and Sharp, 1898 (including the non-nominate subgenus *Platyschides* Henderson, 1920); *Cadulus* Philippi, 1844; *Dischides* Jeffreys, 1867; *Striocadulus* Emerson, 1962; and *Sagamicadulus* Sakurai and Shimazu, 1963.

An additional genus-group taxon, *Paleodentalium* Gentile 1974, (type species by monotypy, *Dentalium* (*Paleodentalium*) *kansasense* Gentile, 1974, from the Carboniferous of Kansas) was also proposed at this time for Paleozoic dentaliid-like forms with strong longitudinal sculpture (Gentile, 1974).

In the following year, Chistikov (1975) presented a brief review of the classification of the taxa formerly assigned to the family Dentaliidae. His work was stated to be based largely on a study of the morphology of the soft parts and especially the radular characters of "24 species in 11 genera of Dentaliidae," but the species studied were not specified, with the exception of the new species he described. He referred these taxa to the order Dentaliida da Costa, 1776, excluding the family Plagioglyptidae Starobogatov, 1974, which he stated should be placed in a separate, but unnamed ordinal unit. Within the order Dentaliida, he recognized three superfamilies. The first, the superfamily Quasidentalioidea Chistikov, 1975¹, was established by him for the family Quasidentalidae Chistikov, 1975¹, based on the genus *Quasidentalium* Shimansky, 1974 (type species by O. D., *Q. opirarum* Shimansky, 1974, from the Carboniferous of Russia, which has questionable scaphopod affinities, in my opinion).

¹ Denotes the proposal of a new supraspecific taxon by the author cited by year of publication.

In the second superfamily, Dentalioidea Gray, 1834, (in which the family Prodentaliidae Starobogatov, 1974, was placed in synonymy), Chistikov recognized three subfamilies in the nominate family Dentaliidae Gray, 1834. These are the subfamily Dentaliinae Gray, 1834 (genera included: *Dentalium* Linné, 1758, *Coccodentalium* Sacco, 1896, *Fissidentalium* Fischer, 1885, *Compressidentalium* Habe, 1963, and *Schizodentalium* Sowerby, 1894); the subfamily Antalininae Stoliczka, 1858, (genera included; *Antalis* H. and A. Adams, 1854, *Lentigodentalium* Habe, 1963, *Paradentalium* Cotton and Godfrey, 1933, *Striodentalium* Habe, 1964, *Heteroschizmoides* Ludbrook, 1960, and *Spadentalina* Habe, 1963; and genera questionably referred: *Tesseracme* Pilsbry and Sharp, 1898, *Graptacme*, Pilsbry and Sharp, 1897, and *Fustiaria* Stoliczka, 1868); and the subfamily Calliodentaliinae Chistikov 1975¹ (genera included: *Calliodentalium* Habe, 1964, *Pseudantalis* Monterosato, 1884, and questionably *Laevidentalium* Cossman, 1888). Within the superfamily Dentalioidea, he also recognized two non-nominate families. He questionably assigned here the family Gadiliniidae Chistikov, 1975¹, based on the genus-group taxa *Gadilina* Foresti, 1895, and *Bathorhiphus* Pilsbry and Sharp, 1897. He allocated the taxa formerly placed in the genus-group taxon *Episiphon* Pilsbry and Sharp, 1897 to form the family Episiphonidae Chistikov, 1975¹, with the nominate subfamily Episiphoninae Chistikov, 1975¹, together with two other subfamilies. These are the subfamily Anulidentaliinae Chistikov, 1975¹, which is based on the genus *Anulidentarium* Chistikov, 1975¹, type species *A. bambusa* Chistikov, 1975, (a Recent species from the Gulf of Tonkin, Viet Nam) and the subfamily Lobantalinae Chistikov, 1975¹, for the genus group taxon *Lobantale* Cossman, 1888).

In the third superfamilial unit within the order Dentaliida, Chistikov established the superfamily Rhabdoidea Chistikov, 1975¹, with three familial units. In the family Rhabdidae Chistikov, 1975¹, he placed the taxa formerly referred to the genus-group taxon *Rhabdus* Pilsbry and Sharp, 1897, which were restricted to the nominate subfamily, and he proposed the family Eboreidentidae Chistikov, 1975¹, to include the genus *Eboreidens*

Chistikov, 1975¹, (type species by original designation: *Dentalium lacteum* Deshayes, 1825) and the family Omniglyptidae Chistikov, 1975¹, for the genus *Omniglypta* Kuroda and Habe, 1953. The taxa formerly placed in the family Siphonodentaliidae were not covered by Chistikov.

Starobogatov's (1974) recognition of the scaphopods and xenoconchias as subclasses (Scaphopoda Bronn, 1862, and Xenochonchia Shimansky, 1963) within the class Solenoconchia Lacaze-Duthiers, 1857, was based largely on the common presence in these groups of a non-spiral, variously shaped, tube-like shell, which is either open at both ends or is closed at the apical end. As the phyletic relationships of these taxa are still not clear, these diverse organisms can be taxonomically united only on the basis of extreme speculation. Therefore, until more compelling paleontological and neontological data can be marshalled, the scaphopods are best treated as a distinct class of mollusks. With this major exception, the classification outlined for the scaphopods by Starobogatov (1974), and those presented by Palmer (1974) and Chistikov (1975) are largely expansions and modifications of the basic duo-system (families Dentaliidae and Siphonodentaliidae) utilized in the previous classifications. These authors have filled unoccupied ordinal ranks in the former system, and they have assigned higher hierarchical rankings to most of the previously supraspecific categories.

Unfortunately, much more information on the soft anatomy and the radular characters will be required in order to establish the biological and typological validity of many of the familial and generic units proposed by these workers. Starobogatov (1974: 12), for example, concedes that the family Dentaliidae, to which he referred 21 generic taxa, is a composite; "Judging by the structural diversity of the shell and the foot, . . . which has been investigated in only 3-4 genera." Chistikov (1975) based his revision of the "Order Dentaliida" largely on the knowledge of the radular and soft-part morphology of 24 species (only one of which was nomenclaturally identified), that he believed were referable to 11 genus-group taxa. Hopefully, his data will eventually be presented in more detail. In the

meantime students have the option of incorporating elements of these schemes into a revised classification, or to await the publication of better documented investigations. Habe (1977), in a review of the Japanese fauna, utilized some of the higher categories proposed by Palmer and by Chistikov, but he apparently was not aware of Starobogatov's work, which was published a few months prior to that of Palmer. The new taxa proposed by Starobogatov, below the ordinal rank would, of course, have priority over those erected by Palmer.

DESCRIPTIONS

CLASS *Scaphopoda* Bronn, 1862

ORDER *Gadilida* Stoliczka, 1868

[*nom. transl., ex Gadilinae* Stoliczka, 1868]

Syn. *Gadilida* Starobogatov, 1974; *Siphonodentalioida* Palmer, 1974

FAMILY *Gadilidae* Stoliczka, 1868

Syn. *Cadulidae* Grant and Gale, 1931

Genus *Cadulus* Philippi, 1844

Subgenus *Polyschides* Pilsbry and Sharp, 1898

Type species: By O. D., *Cadulus (Polyschides) tetraschides* Watson, 1879, Recent, western Atlantic Ocean.

Cadulus (Polyschides) nedallisoni, n. sp.

Figs. 4-6

Shell is minute, fragile, slender and slightly curved; the convex side is nearly evenly arched; the concave side is straighter, with the maximum diameter of the tube about one-third the distance above the oral aperture (Fig. 4). The swelling is gradual and only slightly inflates the curvature, from which the shell tapers gradually to the apical and oral apertures. The oral aperture is oblique, round and slightly constricted for a short distance above the rim. The lateral sides of the apical rim are indented by four slits, producing four sub-triangular lobes, the two fronting the

concave side being slightly deeper and more rounded than those fronting the convex side (Fig. 5). The terminal edges of the lobes are beveled externally to form a planed surface (Fig. 6). Shells of fresh specimens are glossy, and the tube is translucent; worn specimens are clouded and opaque.

Measurements: holotype 4.56 mm long; outer diameter of apical orifice 0.31 mm, apertural outer diameter 0.56 mm. (Figs. 4, 5). Largest paratype 4.93 mm long; smallest paratype 3.81 mm long (Fig. 6).

Type locality: Corinto, Nicaragua, 12°28'03" N., 87°12'39" W., in 22 to 24 meters, "Zaca" Expedition, Sta. 200-D-19, January 5, 1938.

Type depository: holotype: AMNH no. 160349; 30 paratypes AMNH no. 183875.

Referred specimens: known only from the typological lot.

Range: known only from the type locality.

Remarks: of the eastern Pacific species, this cadulid approaches *Cadulus (Platyschides) austinclarki* Emerson, 1951, in general appearance, but it differs in having different and more prominent apical features and a more fusiform outline, with a less inflated equatorial swelling (cf. Figs. 4-6 with 7-9). The shell of the slightly larger, *C. (P.) tetrodon* Pilsbry and Sharp, 1898 (p. 151, pl. 29, Figs. 14-18) from the western Atlantic is morphologically similar to the present species and may be an east American cognate, or twin species.

Neither of the two species described herein should be confused with specimens of the frequently dredged *Cadulus (Gadila) perpusillus* (Sowerby, 1832), a species which also occurs in the inner sublittoral zone within the Panamic faunal province. Sowerby's taxon, a senior synonym of *C. (G.) panamensis* (Sharp and

FIGS. 1-3 *Cadulus (Platyschides) macleani* n. sp., 1. Holotype, lateral view of entire specimen, approx. 10X. 2. Holotype, lateral view of posterior end enlarged to show apical characters, approx. 20X. 3. Paratype, concave side of posterior end enlarged to show apical characters, approx. 20X. FIGS. 4-6 *Cadulus (Polyschides) nedallisoni* n. sp., 4. Holotype, lateral view of entire specimen, approx. 10X. 5. Holotype, lateral view of posterior end enlarged to show apical characters, approx. 20X. 6. Paratype, 1/4 oblique view with the concave face on the right side enlarged to show apical characters, approx. 20X. FIGS. 7-9 *Cadulus (Platyschides) austinclarki* Emerson, 1951; off San Marcos Island, Baja California del Sur (Gulf of California), in 9-13 meters on sandy bottom, "Puritan" Expedition, Sta. 150, May 10, 1957 (Emerson, 1958), AMNH no. 147140. 7. Lateral view of entire specimen, approx. 10X. 8. Lateral view of posterior end of same specimen (Fig. 7) enlarged to show apical characters. 9. Concave side of posterior end of a specimen enlarged to show apical characters, approx. 20X. (Photography by G. R. Adlington)



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Emerson: New Eastern Pacific Cadulus (explanations on opposite page)

Pilsbry, 1898), has a much larger shell (8+ mm) that is characterized by a simple apical orifice, a conspicuous zone of constriction above the oral aperture, and the common presence of wrinkle like, annular sculpture (Emerson, 1971).

Subgenus *Platyschides* Henderson, 1920

Type species: By O. D., *Cadulus grandis* Verrill, 1884, Recent western Atlantic Ocean.

***Cadulus (Platyschides) macleani*, n. sp.**

Figs. 1-3

Shell is minute, fairly solid, slender, moderately curved and markedly swollen below the posterior half of the tube, especially on the convex side, to form an obtusely angled mid-section (Fig. 1). The concave outline presents a "bent" appearance at the angled equator. The posterior end of the tube is only slightly more attenuated than the anterior end. The circular oral aperture is obliquely contracted. The general appearance of the shell is reminiscent of a miniature canine tooth of a carnivore. The apical orifice is obtusely angled and weakly interrupted on the lateral sides by two shallow indentations on each face that divide the rim into four low lobes with externally beveled edges (Figs. 2, 3). Shells are glossy, semitranslucent.

Measurements: holotype, 4.25 mm long; outer diameter of apical orifice 0.38 mm; apertural outer diameter 0.44 mm. Largest paratype 4.63 mm long; smallest paratype 4.19 mm long.

Type locality: (holotype and 3 paratypes): Muertos Bay, Baja California del Sur, Mexico (Gulf of California), 24° 55' N., 109° 46' W., in 18 to 55 meters on sand and shell bottom; McLean, Oringer and Marincovich, collectors, April 8, 1966, LAMNH (Los Angeles Museum of Natural History) sta. no. 66-22.

Type depository: holotype: LAMNH no. 1886 (Figs. 1, 2); 3 paratypes (1 broken) LAMNH no. 1887, one illustrated, Fig. 3.

Referred specimens: Gulf of California, east coast of Baja California del Sur: Muertos Bay (typological specimens); between Rancho el Tule and Rancho Palmilla, 22° 58' N., 109° 48' W., in 18 to 33 meters on sandy bottom, McLean and Oringer, April 5, 1966, LAMNH no. 66-17, 3 specimens; AMNH no. 183775, 1 specimen.

Range: known only from the east coast of Baja California, from Muertos Bay (24° 55' N.) to near Rancho Palmilla (22° 58' N.), in 18 to 55 meters.

Remarks: This is the smallest of the known eastern Pacific gadilian species. None of the other west American species possesses a "bent" appearance resulting from the obtusely angled equator. Henderson (1920, p. 122) refers to similar shaped specimens in the western Atlantic as "wolf-tooth" species, namely: *Cadulus (Platyschides) vulpidens* Watson, 1878 and *C. (P.) providensis* Henderson, 1920. Both of these east American taxa have much larger shells (more than twice the length of the present species), and they are recorded from much deeper water, 713 and 699 meters, respectively.

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A CASE OF DOUBLE PRIMARY HOMONYMY IN EASTERN PACIFIC LITTORINIDAE

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ABSTRACT

Littorina keenae, new name for *Littorina planaxis Philippi*, 1847, non *Littorina planaxis Sowerby*, 1844; and for *Littorina patula Gould*, 1849, non *Littorina patula Thorpe*, 1844.

In the course of a systematic study of West African Littorinidae a case of double primary homonymy was discovered which unavoidably necessitates that a replacement name be provided for the well-known eastern Pacific species, *Littorina planaxis Philippi*, 1847.

The facts are these:

A. 1.) The combination *Littorina planaxis* 'Nuttall' Jay, 1839, p. 73, published in association with the locality, "Upper California", is a *nomen*

nudum and is not available as a contender for priority.

2.) *Littorina planaxis* Sowerby, 1844, p. 153, was validly introduced for a Tertiary fossil species from St. Jago, Cape Verde Islands (see Sherborn, 1929, p. 5007).

3.) *Littorina planaxis* Philippi, 1847, p. 201, from "California Superior," was validly introduced for the Recent eastern Pacific species which has been reported to occur from Oregon to Baja California (Yamada, 1977).